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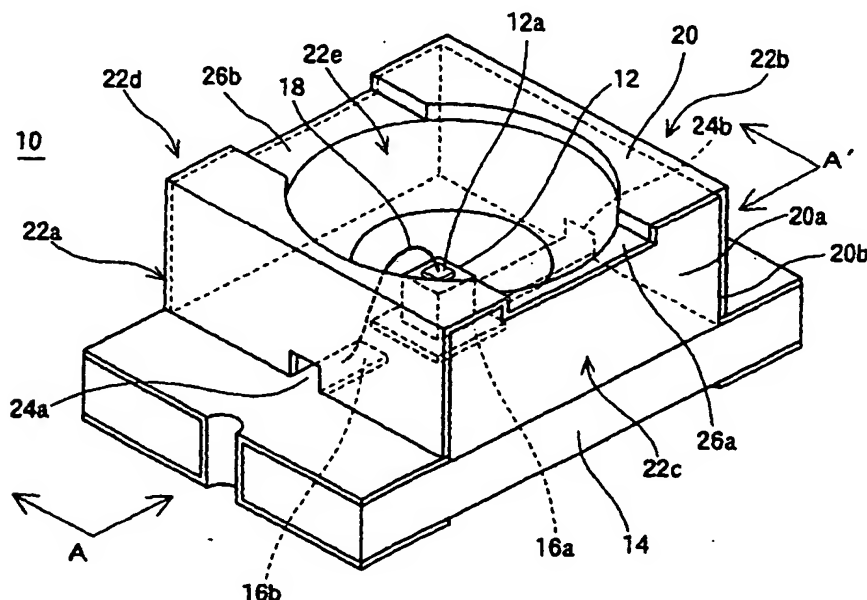
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(54) **LIGHT-EMITTING CHIP DEVICE WITH CASE AND METHOD OF MANUFACTURE THEREOF**

(57) A chip-type light-emitting device (10) with case includes a chip (12), and the chip is die-bonded onto an electrode (16a) formed on a substrate (14). Furthermore, the light-emitting device includes a case (20) having holes (24a, 24b) at an approximately center of respective lower portions on first side surfaces of the case,

and steps (26a, 26b) formed on respective upper edges of second side surfaces. A transparent resin for sealing the chip is filled from the holes to be filled in the case 2. At this time, the transparent resin is flowed from bottom to top in the case, and an air is discharged from an air vent which includes the steps.

**FIG. 1**



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## Description

### TECHNICAL FIELD

[0001] The present invention relates to a chip-type light-emitting device with case and a method of manufacture thereof. More specifically, the present invention relates to a chip-type light-emitting device with case, in which a chip is bonded onto a substrate formed with electrodes, and a resin is filled as a sealant in a case having a rectangular shape in plane and covering the chip on the substrate, and a manufacturing method thereof.

### PRIOR ART

[0002] Such a kind of a conventional chip-type light-emitting device 1 shown in Figure 5 (A) includes a substrate 2, and a semiconductor LED chip (hereinafter briefly referred to as a chip) 4 is die-bonded onto an electrode (lead) 3a formed on a surface of the substrate 2 by silver plate, for example. Furthermore, a bonding wire 5 is wire-bonded to connect a bonding pad 4a formed on an upper portion of the chip 4 to another lead 3b. In addition, in the chip-type light-emitting device 1, a transparent resin 6 is formed on a main surface (upper surface) of the substrate 2 so as to cover the chip 4. A hole 7 is formed at an approximately center of the transparent resin 6, and on a surface of the hole 7, a plating layer 8 is applied as understood from Figure 5 (B) which is a sectional view at a line P-P' shown in Figure 5 (A). Furthermore, a transparent resin 9 is filled in the hole 7 as a sealant, and the chip 4 is sealed. In such the chip-type light-emitting device 1, a number of manufacturing steps was reduced by injecting a resin by a transfer mold (opaque resin 6 and transparent resin 9).

[0003] However, in this prior art, as the transparent resin 9 was injected from above the hole 7 by the transfer mold, air bubbles might be contaminated in the transparent resin 9, i.e. the sealant, or there occurred the unfilling of the transparent resin 9. Therefore, in a case that the chip-type light-emitting device with case was automatically formed by merely applying the transfer mold, a similar problem was brought about.

### SUMMARY OF THE INVENTION

[0004] Therefore, the primary object of the present invention is to provide a chip-type light-emitting device with case and a method of manufacture thereof, capable of stably forming a sealant even when formed by a transfer mold.

[0005] A chip-type light-emitting device with case, according to the present invention is a device in which a chip is bonded onto a substrate formed with electrodes on its surface; and a resin is filled as a sealant in a case having a rectangular shape in plane and covering the chip on the substrate, comprising: holes provided at low-

er portions on first opposite side surfaces of the case; and steps formed on upper edges of second side surfaces sandwiched by the first side surfaces.

[0006] A manufacture method for such a chip-type light-emitting device with case comprises steps of: (a) bonding a chip onto a substrate; (b) arranging a case on the substrate; and (c) forming a sealant by flowing a resin in the case.

[0007] Preferably, the step (a) includes a step (a1) bonding a plurality of chips onto a continuous substrate, and the step (b) includes a step (b1) arranging continuous case on the continuous substrate, and the step (c) includes a step (c1) forming a continuous sealant by filling the resin in the continuous case, and further comprising: (d) dicing a continuous body.

[0008] In this chip-type light-emitting device with case, the electrodes are formed on the substrate, and the chip is bonded onto the electrodes. Furthermore, the case having a rectangular shape in plane is provided to cover the chip, and a resin such as an epoxy resin, for example is filled in the case as the sealant. On the case, the holes are formed in lower portions of the first opposite side surfaces. In addition, on the upper edges of the second side surface, steps are provided. Therefore, when filling a resin, the sealant is injected from the holes (injection ports), and an air is discharged from exhaust vents (air vents) which includes the steps. Due to this, no air bubble is contaminated into the resin, and unfilling of the resin never occurs.

[0009] In other words, such the chip-type light-emitting device with case is formed by flowing a resin from bottom to top in the case.

[0010] For example, if a bonding wire connecting the chip and a lead is bonded in a direction along a flow of the resin intruded through the holes, it is possible to prevent the bonding wire from being damaged mechanically due to the injection of the resin for forming a sealant.

[0011] According to this present invention, it is possible to form a sealant stably even if formed by a transfer mold as no air bubble is contaminated in the resin and no resin is left unfilled.

[0012] The above described objects and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

Figure 1 is an illustrative view showing one embodiment of the present invention;

Figure 2 is an illustrative view showing a sectional view of a chip-type light-emitting device with case shown in Figure 1 embodiment;

Figure 3 is an illustrative view showing a manufacture process of forming a chip-type light-emitting

device with case shown in Figure 1 embodiment; Figure 4 is an illustrative view showing a manufacture process of forming a chip-type light-emitting device with case shown in Figure 1 embodiment; Figure 5 is an illustrative view showing a conventional chip-type light-emitting device with case.

#### BEST FORM FOR PRACTICING THE INVENTION

[0014] Referring to Figure 1, a chip-type light-emitting device with case (hereinafter briefly referred to as light-emitting device) 10 of this embodiment includes a semiconductor light-emitting element (LED chip) 12, and the LED chip 12 is die-bonded onto an electrode (lead) 16a formed on a surface of a substrate 14 by silver paste, for example. Furthermore, a metal thin wire (bonding wire) 18 such as a gold wire is wire-bonded in order to connect a bonding pad 12a provided on the top of the LED chip 12 to another lead 16b. It is noted that in order to be easily understood, the leads 16a and 16b are represented by adding a thickness, in reality, however, they are formed in a thin film. In addition, the leads 16a and 16b are patterned and formed by a lithography process and an etching process on the surface of the substrate 14. Furthermore, the lead 16a and 16b are formed in such a manner as to extend from a one main surface (upper surface) of the substrate 14 to the other main surface (lower surface) via an approximately center portion (throughhole) of a side surface.

[0015] In addition, the light-emitting device 10 includes a case 20 having a rectangular shape in plane (hereinafter briefly referred to as a case), and the case 20 is disposed on the upper surface of the substrate 14 so as to cover the chip 12. The case 20 is formed by an opaque resin 20 on which a plating layer 20b of Ni (Nickel) and Cu (Copper) is applied. In addition, in the case 20, at approximately centers of respective lower portions of the first opposite side surfaces of the 22a and 22b, holes (injection ports) 24a and 24b are formed, and on upper edges of each of second opposite side surfaces 22c and 22d sandwiched by side surfaces 22a and 22b, steps 26a and 26b are formed. It is noted that the steps 26a and 26b are continuously formed up to a hollow 22e at a center of the case 20.

[0016] In addition, as well understood by referring to Figure 2 which is a sectional view at a line A-A' shown in Figure 1, a transparent resin 28 such as an epoxy resin for protecting the chip 12 and the bonding wire 18 is filled in the hollow 22 of the case 20. In other words, the chip 12 is sealed by the transparent resin 28 as a sealant. It is noted that in Figure 1, in order to show simply, the transparent resin 28 is omitted.

[0017] Furthermore, as understood from Figure 2, a cross section of the hollow 22e is formed in a trapezoid-like shape. An oblique line between its upper base and lower base is inclined at such an angle so as to make an entire reflection of a light emitted from the chip 12. In other words, an inner surface of the hollow 22e is

formed in a tapered shape, and the light-emitting device 10 can thus emit a light efficiently.

[0018] When forming such the light-emitting device 10, for example, as shown in Figure 3 (A), a continuous substrate 30 and a continuous case 32 are used to form a plurality of light-emitting devices 10. Although not shown, a plurality of sets of the leads 16a and 16b as described above are respectively formed continuously in longitudinal and lateral directions on a surface of the continuous substrate 30 according to the number of the light-emitting devices to be formed. Furthermore, in the continuous case 32, cases 20 are continuously formed according to the number of the light-emitting devices 10 to be formed. To describe in detail, in the continuous case 32, a plurality of long vents 32a is formed in such a manner as to be tangent to a plurality of hollows 22e formed continuously with predetermined intervals, and although not shown, the injection ports 24a and 24b as described above are formed on contact points of the hollows 22e and the long vent 32a. Furthermore, a plurality of steps 26a and 26b are formed in such a manner as to be parallel to the long vent 32a and to pass through approximately centers of the hollows 20e. Therefore, as understood from Figure 4 which magnifies a part of Figure 3, a groove 36 parallel with the long vent 32a is formed on the hollow 22e which is continuously disposed. It is noted that in Figure 4 a part of a molded product 34 is shown, as understood from Figures 3 (A) and 3 (B), a portion shown in Figure 4 is continued in the longitudinal and lateral directions, and the molded product 34 is then formed.

[0019] Returning to Figure 3 (A) in order to describe a specific method of manufacture (forming), at first, the chips 12 are die-bonded onto each of the plurality of leads 16a formed on the continuous substrate 30. Next, the bonding wires 18 are wire-bonded onto each of the bonding pads 12a and each of the plurality of the leads 16b. Consequently, as shown in Figure 3 (B), the continuous case 32 is mounted on the continuous substrate 30, and the case 32 is heated and then adhered.

[0020] The transparent resin 28 is injected by a transfer mold in the plurality of molded products 34 formed by the continuous substrate 30 and the continuous case 32 which are thus adhered. More specifically, in the molded product 34, a metal mold (not shown) which is formed in such a manner as to be brought into contact to an upper surface of the continuous case 32 is pressed down from above the continuous case 32, and the transparent resin 28 is then injected from one end of the long hole 32a. It is noted that the transparent resin 28 is turned into a tablet-like shape in advance, and injected by being pressurized by a plunger.

[0021] In other words, as understood from Figure 4 showing a part of the molded product 34, the transparent resin 28 runs through an injection path P (a part of the long vent 32a), and is injected from the injection ports 24a and 24b provided on each of the light-emitting devices 10. It is noted that, for the convenience to illustrate

in Figure, an injection path on a side of the injection ports 24b in Figure 4 is omitted, the direction is, however, the same as the injection path P. Furthermore, since the bonding wires 18 are bonded in such a direction as to be along the flow of the transparent resin 28 intruded from the injection ports 24a and 24 b, these bonding wires are not mechanically damaged by injecting the transparent resin 28.

[0022] The transparent resin 28 is thus injected from the injection ports 24a and 24b, that is, flowed from bottom to top in the case 20, and then the transparent resin 28 is filled in the cases 20. When the transparent resin 28 is thus injected, an air is discharged from exhaust vents (air vents) formed by the groove 36 and the metal mold through an exhaust path Q. Due to this, not only no air bubble is not contaminated in the transparent resin 28, but also no unfilling of the transparent resin 28 occurs. Furthermore, a surface of the transparent resin 28 becomes flat, enabling to collect a light outputted from the light-emitting device 10 in a desired direction.

[0023] When the transparent resin 28 is cured by heat, namely, when the chip 12 is sealed, in the following step the molded product 34 is subjected to a dicing, and then a plurality of discrete light-emitting devices 10 is obtained. Subsequently, the transparent resin 28 is injected in the subsequent molded product 34. Thereafter, the same processes described above are carried out to each of the molded products 34.

[0024] According to this embodiment, since the transparent resin is flowed from bottom to top in the case by the transfer mold, and the air is discharged from the exhaust vents, the air bubble is not contaminated in the transparent resin, and unfilling of the transparent resin does not occur. As a result, even if formed by the transfer mold, the sealant can be stably formed. It thus enables to increase the yield.

[0025] It is noted that in this embodiment, only a method of manufacture for a chip-type light-emitting device with case was described. However, such a method of manufacture is also applicable to a chip-type sensor and the like.

[0026] Although the present invention has been described and illustrated in detail, it is clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of the present invention being limited only by the terms of the appended claims.

## Claims

1. A chip-type light-emitting device with case, in where a chip is bonded onto a substrate formed with electrodes, and a resin is filled as a sealant in a case having a rectangular shape in plane and covering said chip on said substrate, comprising:

holes formed at lower portions on first opposite

side surfaces of said case; and  
steps formed on upper edges of second side surfaces sandwiched by said first side surfaces.

2. A chip-type light-emitting device with case according to claim 1, further comprising a bonding wire connecting said chip and said electrodes, wherein said bonding wire is bonded in a direction along a flow of said resin intruded from said holes.

3. A method of manufacture for a chip-type light-emitting device with case which includes a case having a rectangular shape in plane and disposed on the substrate and a sealant formed in the case and for sealing the chip, comprises steps of:

- (a) bonding a chip onto said substrate;
- (b) arranging said case on said substrate; and
- (c) forming said sealant by flowing said resin from bottom to top in said case.

4. A method according to claim 3, wherein,

- said step (a) includes a step (a1) bonding a plurality of chips onto a successive substrate,
- said step (b) includes a step (b1) arranging a continuous case on said successive substrate, and
- said step (c) includes a step (c1) forming a continuous sealant by filling said resin in said continuous case, and further comprising a step of:
  - (a) dicing a continuous body.

5. A method according to claim 3 or 4, wherein in said step (c), the bonding wire is bonded in a direction along a flow of the resin intruded from the holes in said case.

FIG. 1

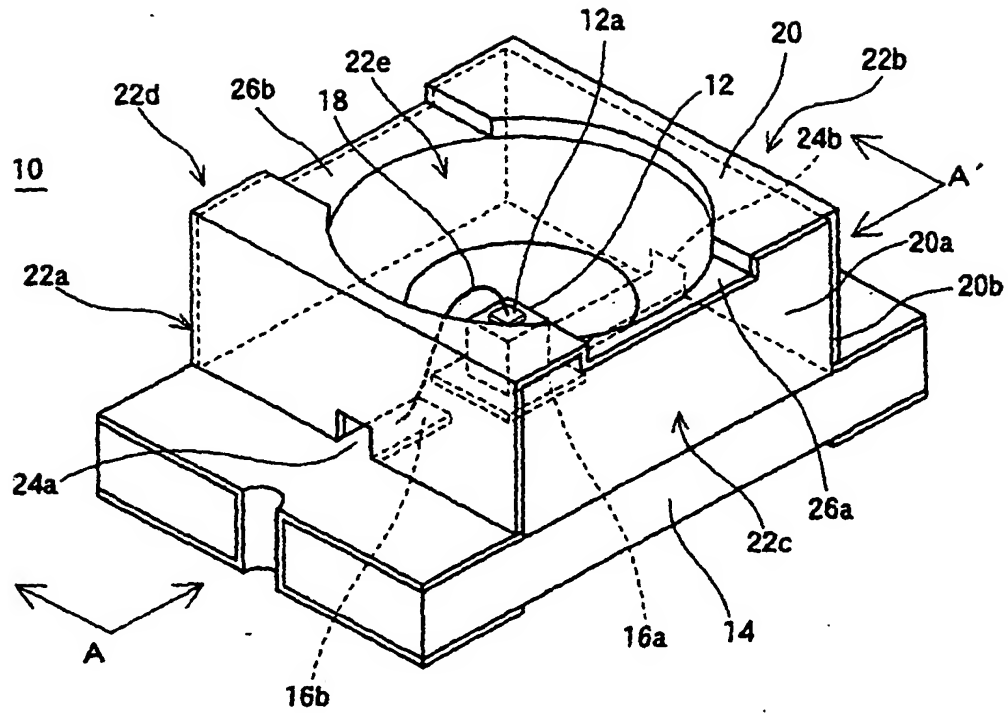


FIG. 2

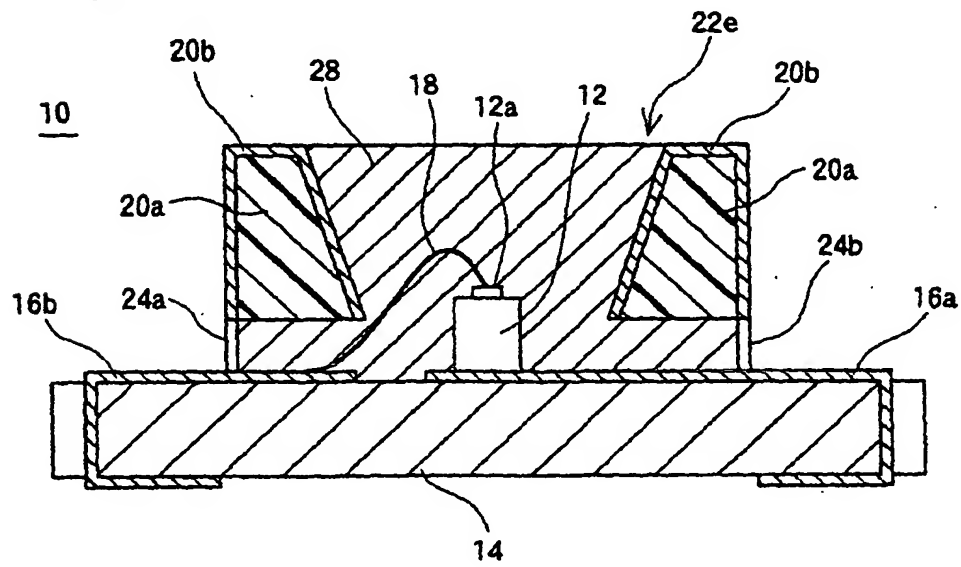
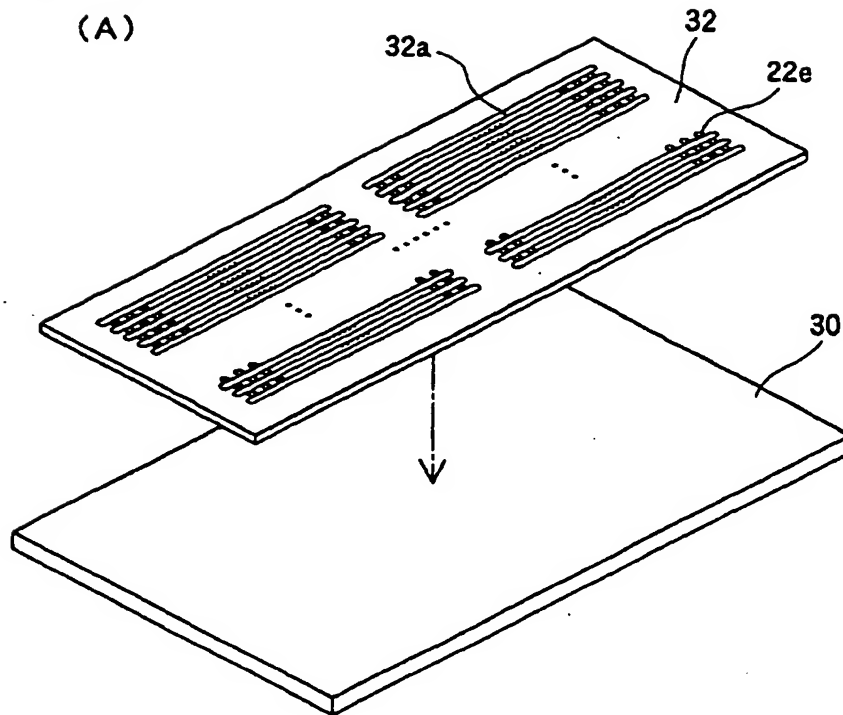


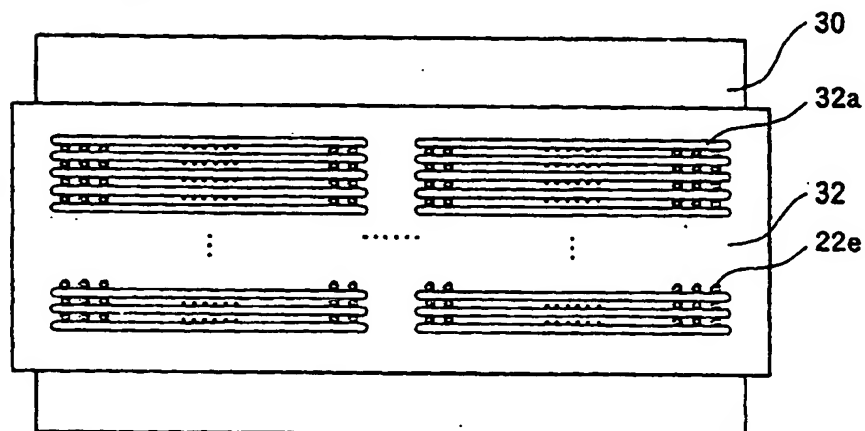
FIG. 3

(A)



(B)

34



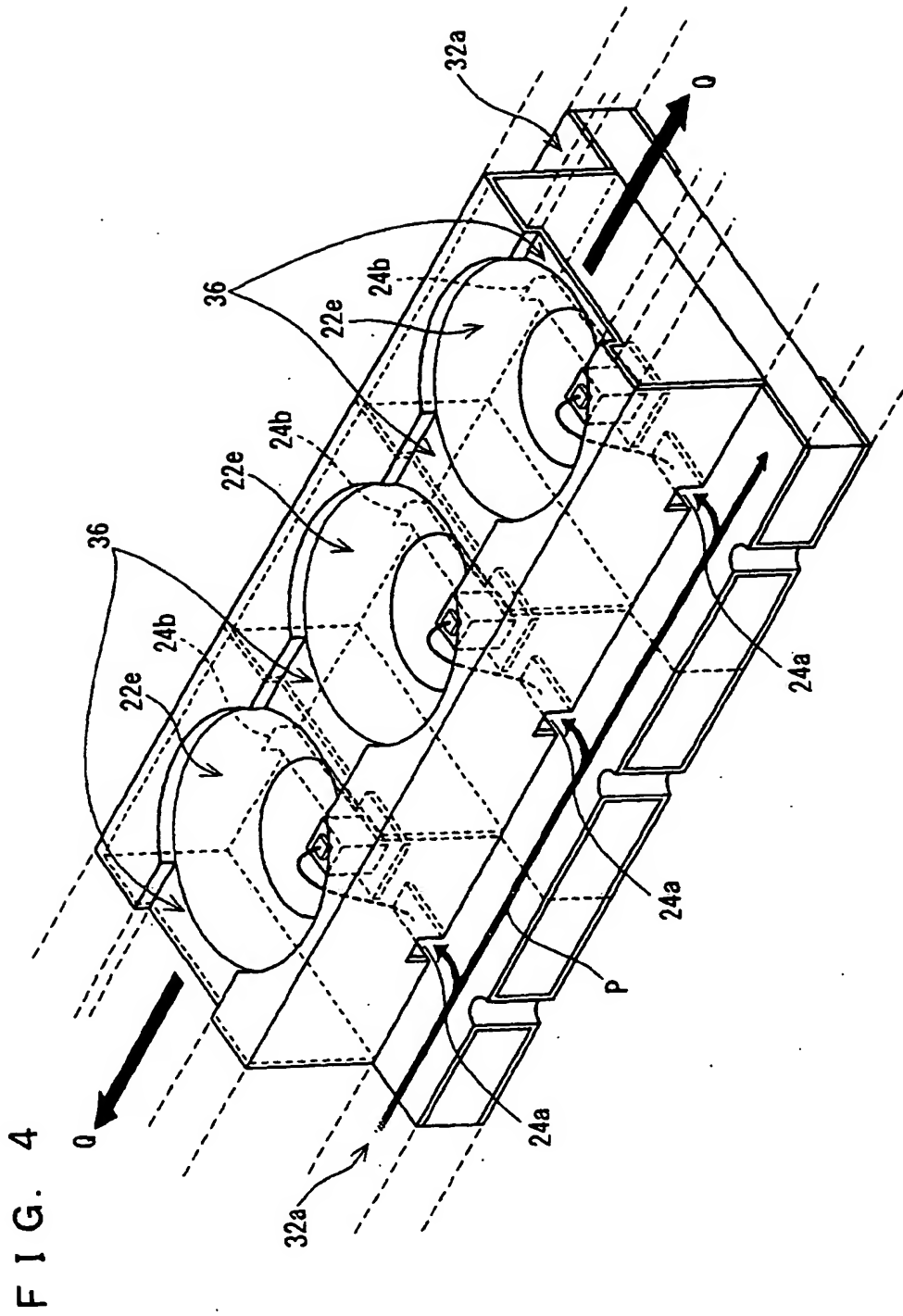
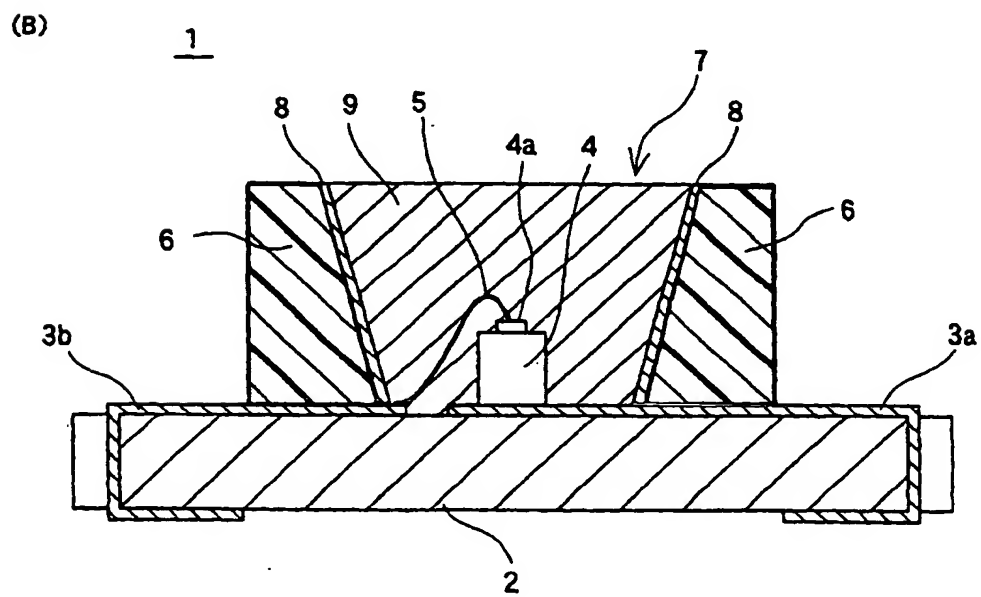
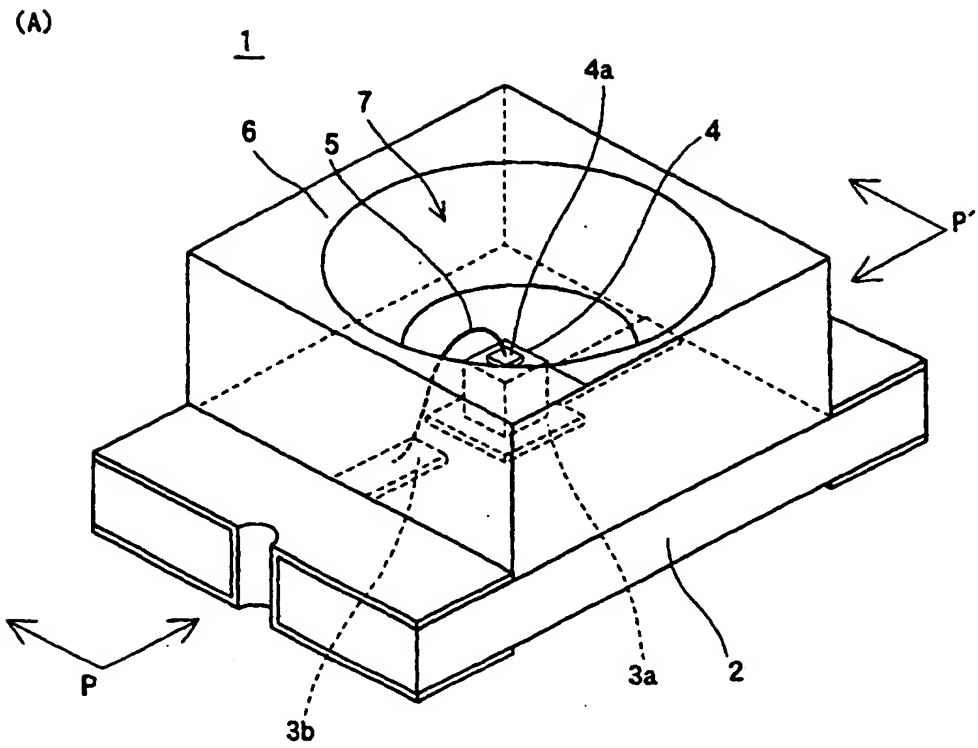


FIG. 5





## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP00/08590

## A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.<sup>7</sup> H01L 33/00  
H01L 23/28  
H01L 21/56

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int. Cl.<sup>7</sup> H01L 33/00 H01S5/022  
H01L 23/28  
H01L 21/56

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
Jitsuyo Shinan Koho 1922-1996 Toroku Jitsuyo Shinan Koho 1994-2001  
Kokai Jitsuyo Shinan Koho 1971-2001 Jitsuyo Shinan Toroku Koho 1996-2001

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP, 1-297869, A (IWASAKI ELECTRIC CO., LTD.), 30 November, 1989 (30.11.89), page 3, lower left column, line 15 to page 4, upper right column, line 8; Fig. 3 (Family: none)	1, 3
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 31753/1991 (Laid-open No. 111768/1992) (KOITO MANUFACTURING CO., LTD.), 29 September, 1992 (29.09.92), Par. Nos. 8 to 9; Fig. 1 (Family: none)	1, 3
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 33372/1979 (Laid-open No. 135469/1980) (NEC Corporation), 26 September, 1980 (26.09.80), page 3, line 12 to page 4, line 18; Figs. 2 to 3 (Family: none)	1, 3
A	JP, 7-231119, A (Mitsubishi Cable Industries, Ltd.), 29 August, 1995 (29.08.95),	2, 4

☒ Further documents are listed in the continuation of Box C.☐ See patent family annex.

\* Special categories of cited documents:

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Date of the actual completion of the international search  
23 February, 2001 (23.02.01)Date of mailing of the international search report  
06 March, 2001 (06.03.01)Name and mailing address of the ISA/  
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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP00/08590

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category <sup>a</sup>	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Par. Nos. 11 to 16; Figs. 2 to 3 (Family: none)	
A	JP, 2-260547, A (Polyplastics Co.), 23 October, 1990 (23.10.90), page 3, upper right column, lines 5 to 16; Fig. 13 (Family: none)	2,4
A	JP, 57-89230, A (Hitachi, Ltd.), 03 June, 1982 (03.06.82), page 2, upper right column, lines 7 to 18; Fig. 2 (Family: none)	2,4
A	JP, 8-32118, A (Rohm Co., Ltd.), 02 February, 1996 (02.02.96), Full text; all drawings (Family: none)	1-4

Form PCT/ISA/210 (continuation of second sheet) (July 1992)